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ABSTRACT

This is one of eighteen sets of individualized mathematics problems developed by the Oregon Vo-Tech Math Project. Each of these problem packages is organized around a mathematical topic and contains problems related to diverse vocations. Solutions are provided for all problems. This volume presents problems involving operations with positive and negative integers. The problems are drawn from the vocational areas of clerical work, aviation mechanics, and forestry. (SD)

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INDIVIDUALIZED
LEARNING
SYSTEMS

Individualized Math Problems in

Integers

Oregon Vo-Tech Mathematics Problem Sets

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Individualized Learning Systems

MATHEMATICS

Integers

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A. Problems with Solutions

1. Let us consider deposits and withdrawals in a savings account. If we deposit $6 today and $10 tomorrow, we have a total deposit
(a) of _____. We may consider these as the deposits of two positive values and the addition of two positive numbers will equal a positive value. Suppose instead we withdraw $6 today and $10 tomorrow. Our total withdrawal will be _____.

For convenience, withdrawals may be considered as negative numbers. If we add the two negative numbers, -$5 and -$10, we get
(b) a total of _____. This implies that the addition of two negative numbers will equal a negative number.

If we deposit $10 in a savings account and make a withdrawal of $5
(c) then we add the positive deposit of + _____ and the negative withdrawal of - _____ and get a net result of + _____.

(d) If we deposit $5 and withdraw $10, then we add the positive deposit of $5 and negative withdrawal of $10 for a net total of - _____.

This leads us to the conclusion that in the addition of two numbers with unlike signs, we determine the difference of the two numbers and take the sign of the larger number.

Solution:

(a) $16, $16 (b) -$15 (c) $10, $5, $5 (d) $5

2. A merchant's transactions had the following results: a gain of $35, a gain of $14.75, a loss of $26.10, a gain of $18.15, a loss of $7.50. Represent his net gain or loss by means of a signed number.

Solution:

+ $35.00
+ $14.75
- $26.10
+ $18.15
- $ 7.50
+ $34.30

A. Problems with Solutions (continued)

3. The following daily net changes in the price of one stock were observed in the course of two weeks: $-1\frac{1}{2}$, $-\frac{1}{2}$, $-1\frac{1}{2}$, $2\frac{1}{2}$, $1\frac{1}{2}$, $\frac{1}{2}$ $3\frac{1}{2}$, 0, $-\frac{1}{2}$, $4\frac{1}{2}$.
Find the average daily net change in price.

Solution:

We must add the signed numbers and find the average.

$$\frac{-1\frac{1}{2} -\frac{1}{2} -1\frac{1}{2} +2\frac{1}{2} +1\frac{1}{2} +\frac{1}{2} +3\frac{1}{2} +0 -\frac{1}{2} +4\frac{1}{2}}{10} = +7/8$$

4. Mr. Jordan owed \$3.56, \$2.34, \$34.43, \$23.25. Two friends owed him \$25 and \$35. What was Mr. Jordan's net financial status?

Solution:

Amount owed by Mr. Jordan = \$3.56 + \$2.34 + \$34.43 + \$23.25
= \$63.58
Amount owed to Mr. Jordan = \$25.00 + \$35.00 = \$60.00

Net Financial Status = \$60.00 - \$63.58 = -\$3.58

B. Problems without Solutions

5. A stock increased in value during the week of March 13, as follows: Monday, 1/8 dollar; Tuesday, $\frac{1}{4}$ dollar; Wednesday, 1/8 dollar; Thursday, 1 1/8 dollar; and Friday, 3/4 dollar. Express the net change in value.

Solution:

6. John Byer owned stock which rose 2 dollars per share the first day, then 1/8 dollar on each of three succeeding days, and $1\frac{1}{4}$ dollars on the fifth. What was the net change in price of the stock in that time?

Solution:

B. Problems without Solutions (continued)

7. Mr. Lescaire had a bank balance of $317.25 on Monday. On Friday the bank said he was overdrawn by $9.47. How much had Mr. Lescaire spent during that period?

Solution:

8. A girls' club took in $13.00 for the semester's dues and paid out $7.50 for refreshments, $1.25 for programs, and $2.00 for a charity project. Their share in the proceeds of the class play was $6.50. Use a signed number to represent the financial condition of the club.

Solution:

9. Al Herrick's stock fell ¼ dollar per share the first day he owned it. It continued to fall 1/8 dollar for each of the next two days. Express the change in value of a share of this stock during these three days.

Solution:

Complete Solutions to B Problems

5. The stock always increased; therefore, all values are positive.

Net change = 1/8 + 1/4 + 1/8 + 1 1/8 + 3/4
= 1/8 + 2/8 + 1/8 + 9/8 + 6/8
= 19/8 = +2 3/8

6. The stock always increased; therefore, all values are positive.

Net change = 2 + 1/8 + 1/8 +1/8 +1 1/2
= 2 + 3/8 + 1 4/8
= +3 7/8

7. He spent a total of
$317.25
+ 9.47
$326.72

8. Financial condition =
+$13.00
- 7.50
- 1.25
- 2.00
+ 6.50
+$ 8.75

9. The stock always decreased; therefore, all values are negative.

Net change = -1/2 -1/8 -1/8
= -4/8 -1/8 -1/8
= -6/8 = -3/4

A. Problems with Solutions

1. If the center of the main wheels is the reference point (DATUM), compute the CG (center of gravity) for a tricycle-gear airplane which has the nose wheel 75 inches ahead of main wheels and which has the following weights:

Right wheel	816 lb
Left wheel	810 lb
Nose wheel	320 lb

Solution:

The moment (product of weight and arm distance from reference point or datum) for each weight must be determined, and then the total of these divided by the total weights will give CG. If the arm is in a direction forward of the datum, the sign is negative.

Item	(Weight)	(Arm)	=	Moment
Right wheel	(816 lb)	(0)	=	0
Left wheel	(810 lb)	(0)	=	0
Nose wheel	(320 lb)	(-75)	=	-24,000 in-lb
	1946 lb			

then, $\frac{-24{,}000 \text{ in-lb}}{1{,}946 \text{ lb}}$ = -12.33 inches (CG distance of MWCL)

The center of gravity is 12.33 inches forward of the mainwheel center line.

2. The EWCG (empty weight center of gravity) of an airplane is +25, and the empty weight is 1,100 lb. When a 15-lb generator is installed at -21 (arm) and a 12-lb battery is installed at -40, what is the new CG location?

Solution

Item	(weight)	(arm)	=	Moment
Aircraft	(1100 lb)	(+25)	=	+27,500
Generator	(15 lb)	(-21)	=	- 315
Battery	(12 lb)	(-40)	=	- 480
	1127 lb			+26,705 in-lb

New CG location $\frac{+26{,}705 \text{ in-lb}}{1127 \text{ lb}} \approx 23.7$ inches

B. Problems without Solutions

3. The Arm represents the distance an object is located from the Datum (reference point). If the nose of an airplane is the datum, find the CG (Center of Gravity) of a plane with the following measures.

Item	Weight	Arm
Right wheel	816 lbs	+115
Left wheel	810 lbs	+115
Nose wheel	320 lbs	+40

B. Problems without Solutions (continued)

4. The following items were added to an aircraft whose weight is 1,324 and arm is 38.4.

Item	Weight	Arm
Radio rack	1.5 lb	123.0 inch
Narco VOA-3 VHF Conv	4.3	123.0
Narco Mk V	6.0	10.0
T-12 MP7	3.5	3.0
Narco C53-A	1.0	14.0

Find the new center of gravity (ARM).

B. Problems without Solutions (continued)

5. If the following items are to be added,

Item	Weight	Arm
VTR-2	7.0 lb	0 inch
V12 MP-2A	6.9	-15

and the following

L TRAG	6.5 lb	0 inch
Meter	2.9	0
OMNIPAK	10.0	67

are to be removed from an aircraft whose weight is 1,112.9 lbs and arm 11, what is the new center of gravity?

B. Problems without Solutions (continued)

6. An owner of an airplane with an empty weight of 1,220 pounds and an EWCG (empty weight center of gravity) at +25 wishes to install new radio equipment weighing 15 pounds, arm at +65, and a new 14-pound generator with arm at -21 to replace an old generator weighing 11 pounds with arm at -215. Find the CG.

B. Problems without Solutions (continued)

7. The following problem is in two parts. Compute the center of gravity of a plane with respect to the centerline of the main wheel if the tail wheel is 160 inches aft of the main wheels. The weights of the wheels are:

Right wheel	380 lb
Left wheel	585 lb
Tail wheel	130 lb minus 20 lb tare = 110 lb

Continuing, suppose the above weights include 2 gallons of oil still in the engine where the oil arm is given as -20 in the specifications, find the EWCG.

Complete Solutions to B Problems

3. The sum of the moments (product of weight and arm) divided by total weight gives the CG

(816 lb)(+115)	=	+93,840 in-lb
(810 lb)(+115)	=	+93,150
(320 lb)(+40)	=	+12,800
1,946 lb		199,790 in-lb

So, $\frac{199,790 \text{ in-lb}}{1,946 \text{ lb}} = +102.17$ inches

i.e., the center of gravity is 102.67 inches aft of the nose. This result agrees with a previous problem with similar data, in which the datum was taken to be the center of main wheels. That is, 102.67 + 12.33 = 115. The point is, the location of the datum is arbitrary. Result should be same regardless of where datum is chosen.

4.

Item	(Weight)	(Arm)	=	Moment
Aircraft	1324.0 lb	38.4 inch	=	50,841.6 lb-in
Radio rack	1.5 lb	123.0 inch	=	184.5
Narco VOA-3 VHF Conv	4.3 lb	123.0 inch	=	528.9
Narco Mk V	6.0 lb	10.0 inch	=	60.0
T-12 MP7	3.5 lb	3.0 inch	=	10.5
Narco C53-A	1.0 lb	14.0 inch	=	14.0
	1340.3 lb			51,639.5 lb-in

$\frac{51,639.5 \text{ lb-in}}{1,340.3 \text{ lb}}$ 38.5 inches aft of datum

5.

Item	(Weight)	(Arm)	=	Moment
Aircraft	1112.9 lb	11 inch	=	12,241.9 lb-in
VTR-2	+7.0 lb	0	=	0
V12 MP-2A	+6.9 lb	-15 inch	=	-103.5
L TRAG	-6.5 lb	0	=	0
Meter	-2.9 lb	0	=	0
Omnipak	-10.0 lb	67 inch		-670.0
	1107.4 lb			11,468.4 lb-in

$\frac{11,463.4 \text{ lb-in}}{1,107.4 \text{ lb}}$ 10.3 inches aft of reference. If the datum line is 60 inches forward of reference point, then, the new CG is 70.3 inches aft of datum line.

Complete Solutions to B Problems (continued)

6.

Item	(Weight)	(Arm)	=	Moment
Airplane (empty)	1220 lb	+25.0 inch	=	+30,500.0 lb-in
Radio	15 lb	+65.0 inch	=	+975.0
Generator (removed)	-11 lb	-21.5 inch	=	+236.5
Generator (installed)	+14 lb	-21.0 inch	=	-294.0
New Empty Wt	1238 lb			+31,417.5 lb-in

$$\frac{+31{,}417.5 \text{ lb-in}}{1{,}238 \text{ lb}} = +25.38 \text{ inches new empty CG}$$

7.

Item	Weight	Tare	Nt Weight	Arm	Moment
Right Wheel	580 lb	0	580 lb	0	0
Left wheel	585 lb	0	585 lb	0	0
Tail wheel	130 lb	20	110 lb	160 in	17,600 lb-in
			1275 lb		17,600 lb-in

So, $\frac{17{,}600 \text{ lb-in}}{1{,}275 \text{ lb}} = +13.8$ inches CG aft of MWCL

If the datum line in this problem is 8 inches forward of MWCL, then, the CG is 13.8 + 8 = 21.8 with respect to the datum line.

Item	Weight	Arm	Moment
Airplane	1,275 lb	21.8 in	+27,795 lb-in
Oil (removed)	-15 lb	-20.0 in	+300
	1,260 lb		28,095 lb-in

$$\text{EWCG} = \frac{+28{,}095 \text{ lb-in}}{+1{,}260 \text{ lb}} = +22.29 \text{ inches}$$

A. Problems with solutions.

1. In constructing a forest service road it is important to investigate drainage conditions so it is essential to determine the location of the low (or high) point on a vertical curve.

$x = \frac{g_1 L}{g_1 - g_2}$ where: x = distance from beginning of curve to high or low point of curve (stations)

g_1 = tangent grade through start of curve(%)

g_2 = tangent grade through start of curve(%)

Determine x given:

a) $g_1 = -2.00\%$, $g_2 = +1.60\%$, L = 8 stations

b) $g_1 = +1.80\%$, $g_2 = -2.10\%$, L = 10 stations

Solutions:

a) $x = \frac{-2.00\% \text{ (8) stations}}{-2.00\% - 1.60\%} = \frac{-16.00 \text{ stations}}{-3.60} = 4.44 \text{ stations}$

b) $x = \frac{1.80\% (10 \text{stations})}{1.80\% - (2.10\%)} = \frac{18.00 \text{ stations}}{+3.90} = 4.62 \text{ stations}$

B. Problems without solutions.

2. In determining error of closure in traverse computations the closure in latitude is determined by algebraically summing all of the latitudes while the closure in departure is similarly obtained. A positive latitude indicates north and negative indicates south while a positive departure denotes east, while west is negative.

For each of the following traverse computations determine the error of closure in latitude and departure.

a)

Departure	Latitude
+143.05	+220.02
+573.78	-117.70
-175.22	-590.82
-23.53	+99.43
-517.45	+389.01

b)

Departure	Latitude
+202.90	-6.07
+256.02	-517.55
-625.08	137.61
-153.52	-204.64
+319.69	590.65

Complete solutions to B problems.

2 Solution:

a) error of closure:

departure : (+143.05 +573.78) +(-175.22 - 23.53 - 517.45)

= 716.83 +(-716.20) = +0.63

latitude : (+220.02 + 99.43 +389.01) + (-117.70 - 590.82)

= +708.46 + (-708.52) = -0.06

b) error of closure:

departure : (+202.90 + 256.02 + 319.69) + (-625.08 - 153.52)

= 778.61 + (-778.60) = +0.01

latitude : (137.61 + 590.65) + (-6.07 - 517.55 - 204.64)

= +728.26 + (-728.26) = 0.00